MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

EEE 7236 – POWER ELECTRONICS AND ELECTRICAL MACHINES

13 MARCH 2019

(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages including cover page with 4 Questions only.
2. Answer ALL questions. The distributions of the marks for each question are as stated.
3. Please write all your answers in the Answer Booklet provided.

Question 1

a) Describe **TWO** methods of classifying power electronic devices. [6 Marks]

b) i) Identify **TWO** applications of diode. [7 Marks]
ii) Illustrate the applications with appropriate circuits and support your illustration with brief description of how the circuits operate. [7 Marks]

c) Second breakdown the destructive phenomenon of BJT. Explain the negative implication of second breakdown and propose TWO mitigations to counter it. [5 Marks]

Question 2

a) Explain the differences between rectifier, inverter and converter. [16 Marks]

b) A boost converter as shown in Figure 2(b) has an input voltage of 10V. The average output voltage and average load current are 12V and 1A respectively. The switching frequency is 50kHz. If L=200μH and C=350μF, determine the duty cycle, critical value of capacitor and inductor to achieve continuous output voltage and current respectively. [7 Marks]

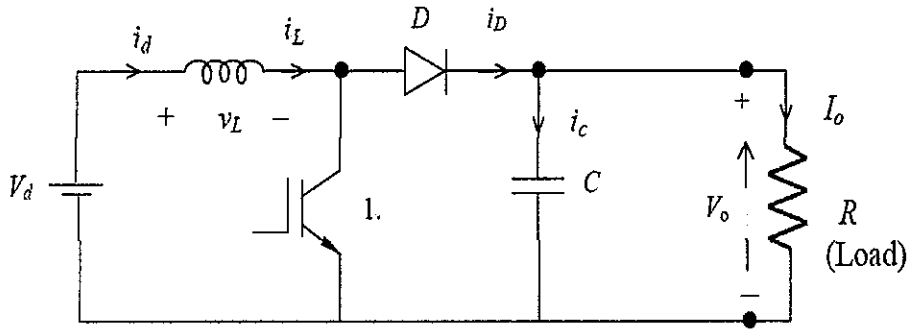

Figure 2(b)

c) State **TWO** limitations of a single stage conversion. [2 marks]

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Question 3

(a) List **FOUR** modifications for a DC series motor to be used as a universal motor for AC supply input. [4 Marks]

(b) A short-shunt cumulative compound DC motor of 6000W, 250V, 1800rpm has an armature circuit resistance of 0.3Ω, the series field resistance is 0.2Ω and the shunt field resistance is 120Ω. If the rotation loss is 300W. Obtain the followings:

i. The equivalent circuit and label them. [3 Marks]
ii. Copper losses of (P_{CS}) and (P_{CR}) [4 Marks]
iii. The developed torque (τ_d) [3 Marks]
iv. The shaft torque (τ_{out}) [3 Marks]
v. The efficiency (η) [1 Mark]
vi. The power flow diagram and label them with calculated values. [3 Marks]

(c) State **TWO** key points for servo motor and stepper motor between its characteristics. [4 Marks]

Question 4

(a) Name **THREE** methods of speed control in a squirrel cage induction motor. [3 Marks]

(b) A six step brushless DC motor (BLDC) has 2 pole rotor and 3 pole stator with sequence of RGB (Red, Green, Blue). There is three hall effect connected. The rotor turns clockwise.

i) Draw the cross section of the BLDC motor. [4 Marks]

ii) Draw the circuit connection between the BLDC in section b(i) to its PLC control circuit with a proper labelling. [4 Marks]

iii) Plot the timming diagram for one mechanical rotation of the BLDC. You are requiered to draw three hall effect input and three semiconductor switching output diagram all in one plot. [7 Marks]

(b) A 480V, 60Hz, 400-hp, 0.8pf leading, 8 pole, delta connected, synchronous motor has a synchronous reactace of 0.6Ω and negligible amature resistance. Ignore friction, windace and core loss for the purpose of this problem. Obtain the following:

i) The speed of this motor. [1 Mark]

ii) The magnitude of E_A and I_A, if the motor is initially supplying 400hp at 0.8pf lagging. [3 Marks]

iii) The vector diagram with a label of the values of torque angle δ with values. [1 Mark]

iv) The produced torque of this motor. [2 Marks]

End of Paper